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(54) **APPARATUS AND METHOD TO CONTROL RECONNECTION OF A TERMINAL DEVICE TO A WIRELESS NETWORK VIA ANOTHER WIRELESS NETWORK**

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(52) **U.S. Cl.**

CPC ***H04W 76/028*** (2013.01); ***H04L 61/2038*** (2013.01); ***H04W 48/10*** (2013.01)

(57) **ABSTRACT**

An apparatus obtains connection status information of each of terminal devices coupled to a first wireless network via an access point, from the access point. The apparatus detects a disconnected device which is a terminal device whose communication with the access point is disconnected, with reference to the connection status information, and notifies, by using a second wireless network, the disconnected device of a reconnection instruction for instructing the disconnected device to reconnect to the first wireless network by accessing the access point.

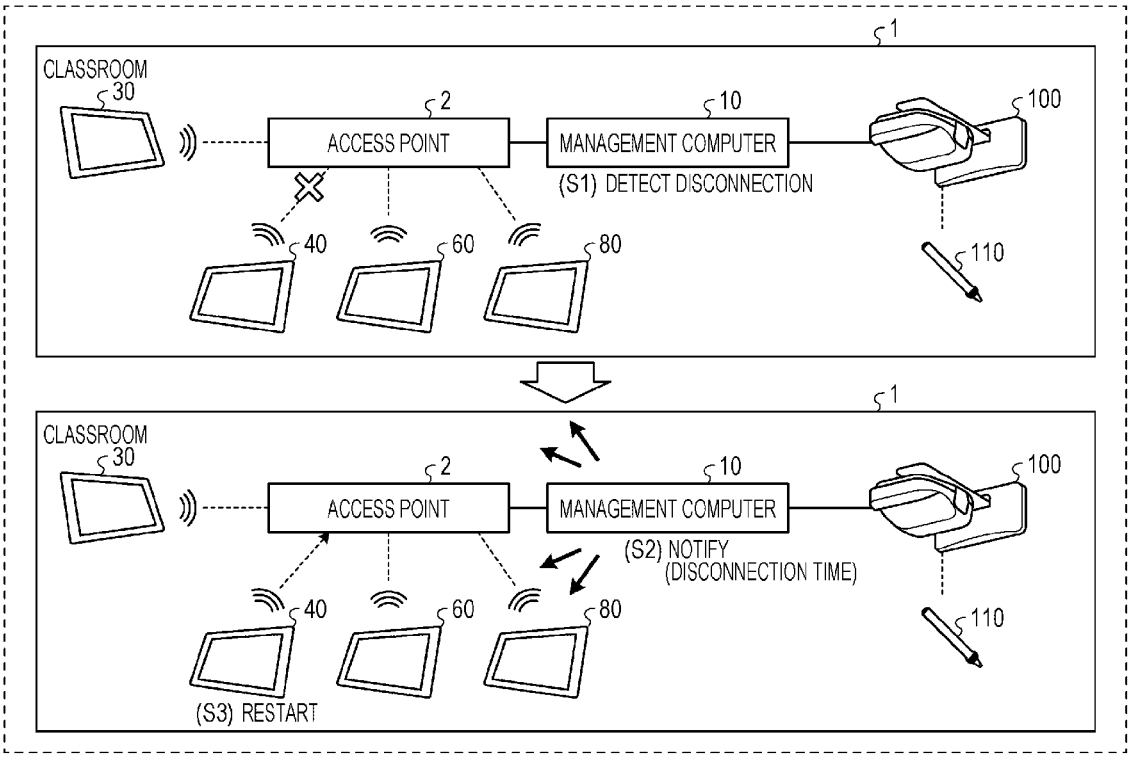


FIG. 1

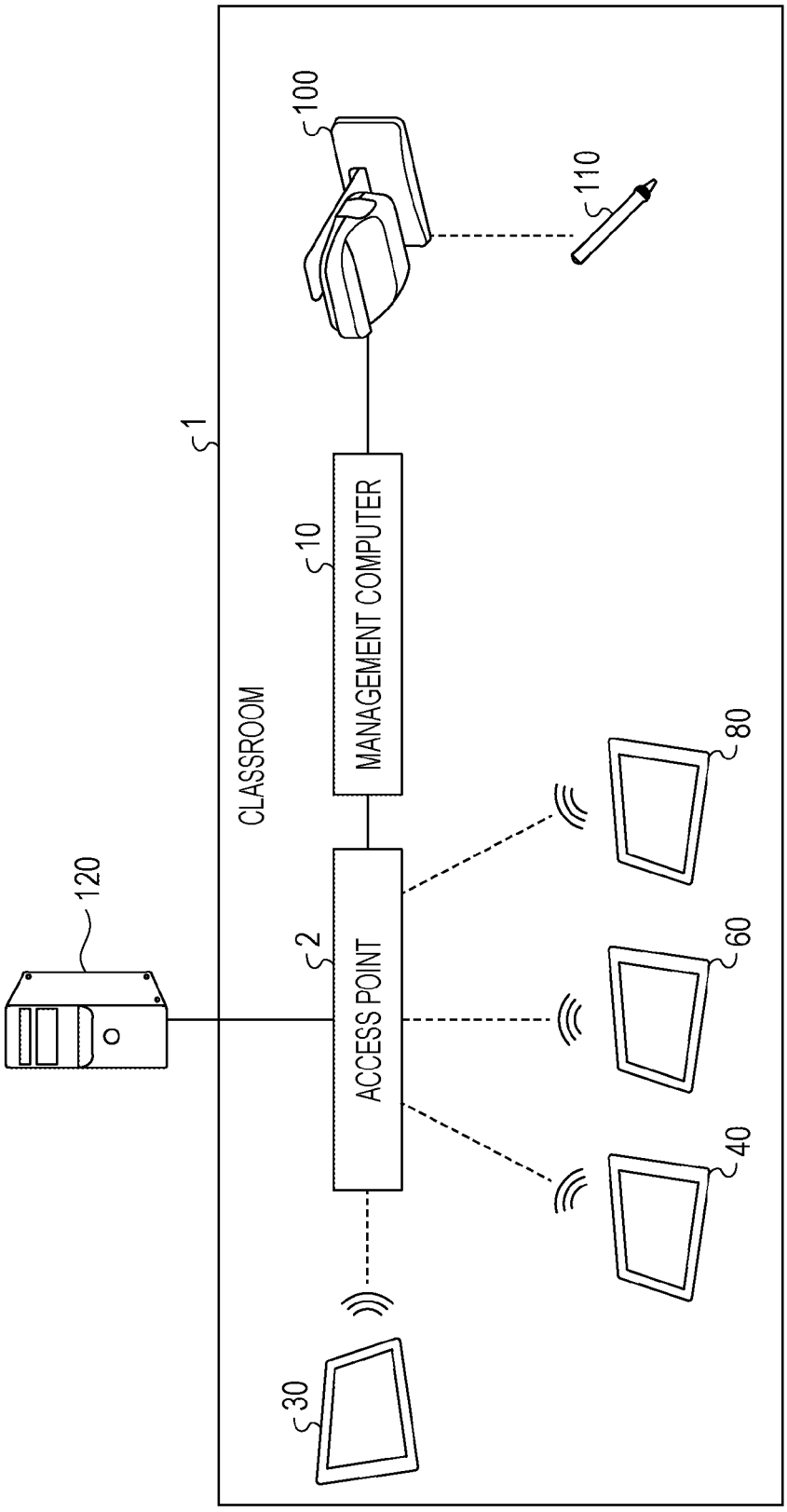

100
110
1
CLASSROOM
10
MANAGEMENT COMPUTER
80
120
2
ACCESS POINT
60
40
30

FIG. 2

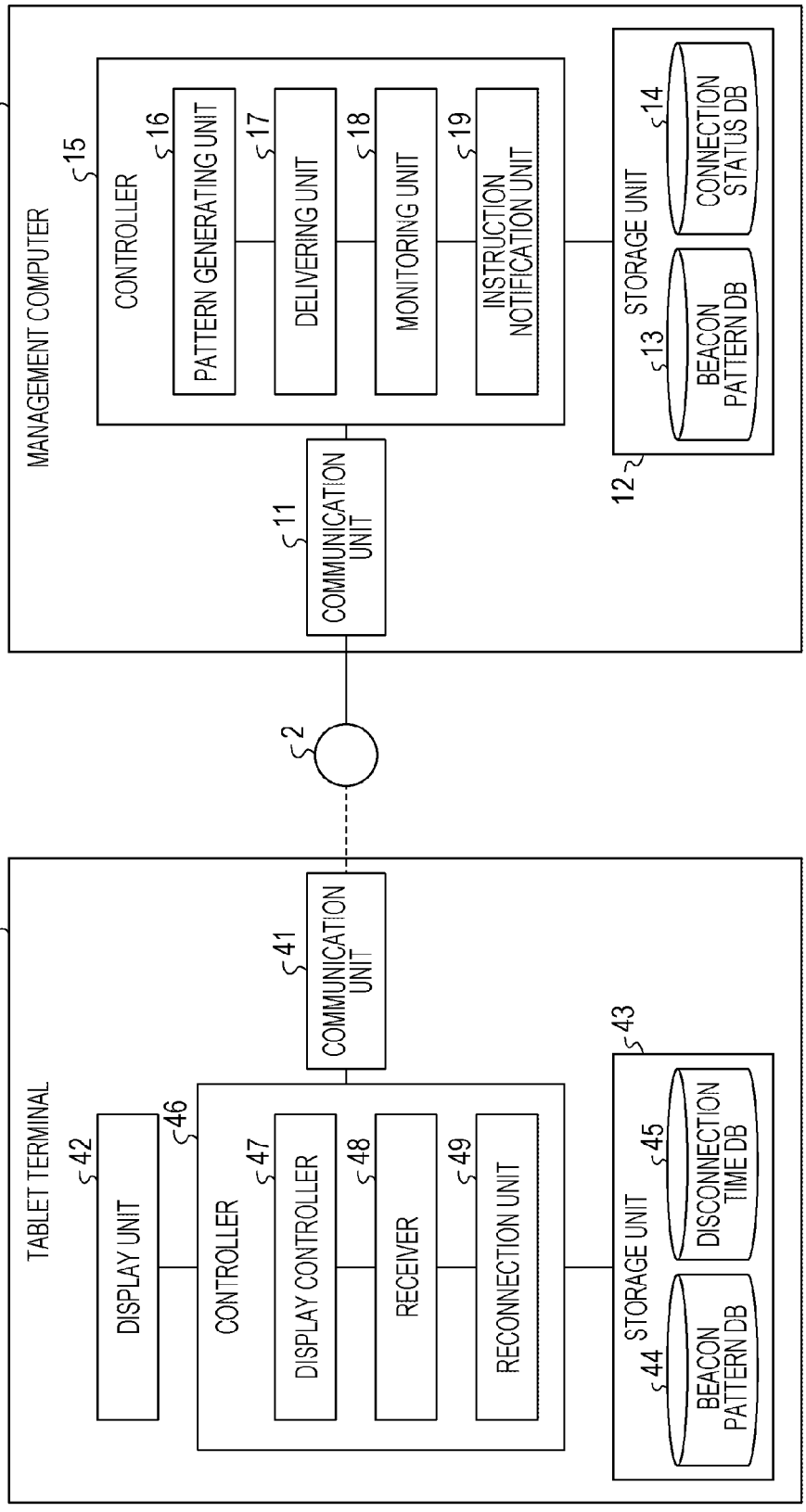

10
MANAGEMENT COMPUTER
15
CONTROLLER
16
PATTERN GENERATING UNIT
17
DELIVERING UNIT
18
MONITORING UNIT
19
INSTRUCTION NOTIFICATION UNIT
11
COMMUNICATION UNIT
12
STORAGE UNIT
13
BEACON PATTERN DB
14
CONNECTION STATUS DB
2
40
TABLET TERMINAL
41
COMMUNICATION UNIT
42
DISPLAY UNIT
46
CONTROLLER
47
DISPLAY CONTROLLER
48
RECEIVER
49
RECONNECTION UNIT
43
STORAGE UNIT
44
BEACON PATTERN DB
45
DISCONNECTION TIME DB

FIG. 3

TABLET TERMINAL	MAC ADDRESS	TRANSMISSION CHANNEL		
		FIRST TIME	SECOND TIME	THIRD TIME
STUDENT A	A1:B2:C3:F3:E2:D1	37 ch	37 ch	37 ch
STUDENT B	A1:B2:C3:F3:E2:D2	37 ch	37 ch	38 ch
STUDENT C	A1:B2:C3:F3:E2:D3	37 ch	37 ch	39 ch
STUDENT D	A1:B2:C3:F3:E2:D4	37 ch	38 ch	37 ch
STUDENT E	A1:B2:C3:F3:E2:D5	37 ch	38 ch	38 ch
STUDENT F	A1:B2:C3:F3:E2:D6	37 ch	38 ch	39 ch
STUDENT G	A1:B2:C3:F3:E2:D7	37 ch	39 ch	37 ch
STUDENT H	A1:B2:C3:F3:E2:D8	37 ch	39 ch	38 ch
STUDENT I	A1:B2:C3:F3:E2:D9	37 ch	39 ch	39 ch
STUDENT J	A1:B2:C3:F3:E2:DA	38 ch	37 ch	37 ch
STUDENT K	A1:B2:C3:F3:E2:DB	38 ch	37 ch	38 ch
STUDENT L	A1:B2:C3:F3:E2:DC	38 ch	37 ch	39 ch
STUDENT M	A1:B2:C3:F3:E2:DD	38 ch	38 ch	37 ch
STUDENT O	A1:B2:C3:F3:E2:DE	38 ch	38 ch	38 ch
STUDENT P	A1:B2:C3:F3:E2:DF	38 ch	38 ch	39 ch
STUDENT Q	A1:B2:C3:F3:E2:E0	38 ch	39 ch	37 ch
STUDENT R	A1:B2:C3:F3:E2:E1	38 ch	39 ch	38 ch
STUDENT S	A1:B2:C3:F3:E2:E2	38 ch	39 ch	39 ch
STUDENT T	A1:B2:C3:F3:E2:E3	39 ch	37 ch	37 ch
STUDENT U	A1:B2:C3:F3:E2:E4	39 ch	37 ch	38 ch
STUDENT V	A1:B2:C3:F3:E2:E5	39 ch	37 ch	39 ch
STUDENT W	A1:B2:C3:F3:E2:E6	39 ch	38 ch	37 ch
STUDENT X	A1:B2:C3:F3:E2:E7	39 ch	38 ch	38 ch
STUDENT Y	A1:B2:C3:F3:E2:E8	39 ch	38 ch	39 ch
STUDENT Z	A1:B2:C3:F3:E2:E9	39 ch	39 ch	37 ch
STUDENT α	A1:B2:C3:F3:E2:EA	39 ch	39 ch	38 ch
STUDENT β	A1:B2:C3:F3:E2:EB	39 ch	39 ch	39 ch

FIG. 4

TABLET TERMINAL	MAC ADDRESS	STATUS	DISCONNECTION TIME	DISCONNECTION REASON
STUDENT A	A1:B2:C3:F3:E2:D1	CONNECTING	—	—
STUDENT B	A1:B2:C3:F3:E2:D2	CONNECTING	—	—
STUDENT C	A1:B2:C3:F3:E2:D3	UNCONNECTED	9:45	UNEXPECTED DISCONNECTION
STUDENT D	A1:B2:C3:F3:E2:D4	CONNECTING	—	—
STUDENT E	A1:B2:C3:F3:E2:D5	CONNECTING	—	—
STUDENT F	A1:B2:C3:F3:E2:D6	CONNECTING	—	—
STUDENT G	A1:B2:C3:F3:E2:D7	CONNECTING	—	—
STUDENT H	A1:B2:C3:F3:E2:D8	CONNECTING	—	—
STUDENT I	A1:B2:C3:F3:E2:D9	CONNECTING	—	—
STUDENT J	A1:B2:C3:F3:E2:DA	CONNECTING	—	—
STUDENT K	A1:B2:C3:F3:E2:DB	CONNECTING	—	—
STUDENT L	A1:B2:C3:F3:E2:DC	CONNECTING	—	—
STUDENT M	A1:B2:C3:F3:E2:DD	CONNECTING	—	—
STUDENT O	A1:B2:C3:F3:E2:DE	CONNECTING	—	—
STUDENT P	A1:B2:C3:F3:E2:DF	CONNECTING	—	—
STUDENT Q	A1:B2:C3:F3:E2:E0	CONNECTING	—	—
STUDENT R	A1:B2:C3:F3:E2:E1	CONNECTING	—	—
STUDENT S	A1:B2:C3:F3:E2:E2	CONNECTING	—	—
STUDENT T	A1:B2:C3:F3:E2:E3	CONNECTING	—	—
STUDENT U	A1:B2:C3:F3:E2:E4	CONNECTING	—	—
STUDENT V	A1:B2:C3:F3:E2:E5	CONNECTING	—	—
STUDENT W	A1:B2:C3:F3:E2:E6	CONNECTING	—	—
STUDENT X	A1:B2:C3:F3:E2:E7	CONNECTING	—	—
STUDENT Y	A1:B2:C3:F3:E2:E8	CONNECTING	—	—
STUDENT Z	A1:B2:C3:F3:E2:E9	CONNECTING	—	—
STUDENT α	A1:B2:C3:F3:E2:EA	CONNECTING	—	—
STUDENT β	A1:B2:C3:F3:E2:EB	CONNECTING	—	—

FIG. 5

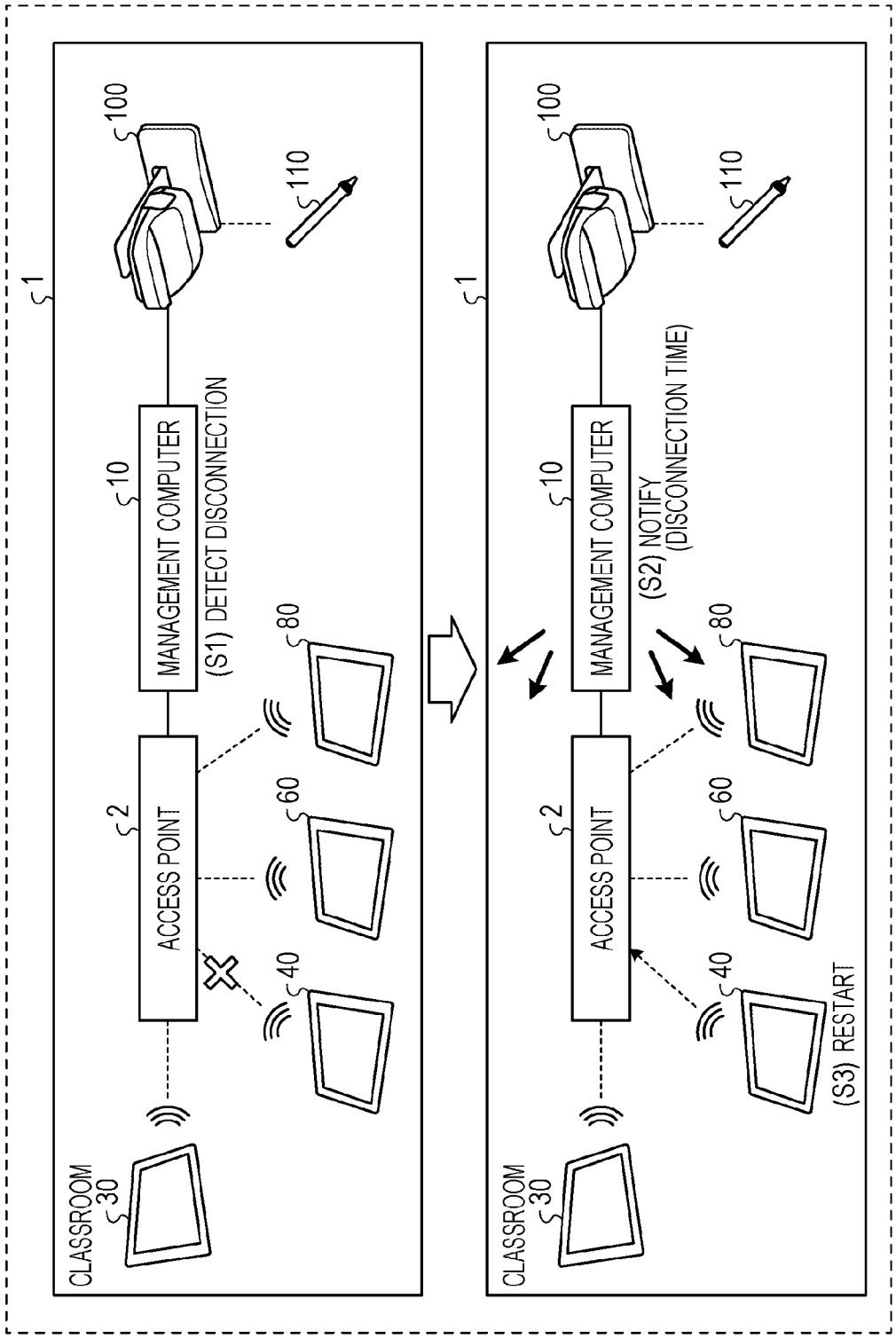

1
100
110
MANAGEMENT COMPUTER
10
(S1) DETECT DISCONNECTION
ACCESS POINT
2
80
60
40
CLASSROOM
30
(S2) NOTIFY
(DISCONNECTION TIME)
(S3) RESTART

FIG. 6

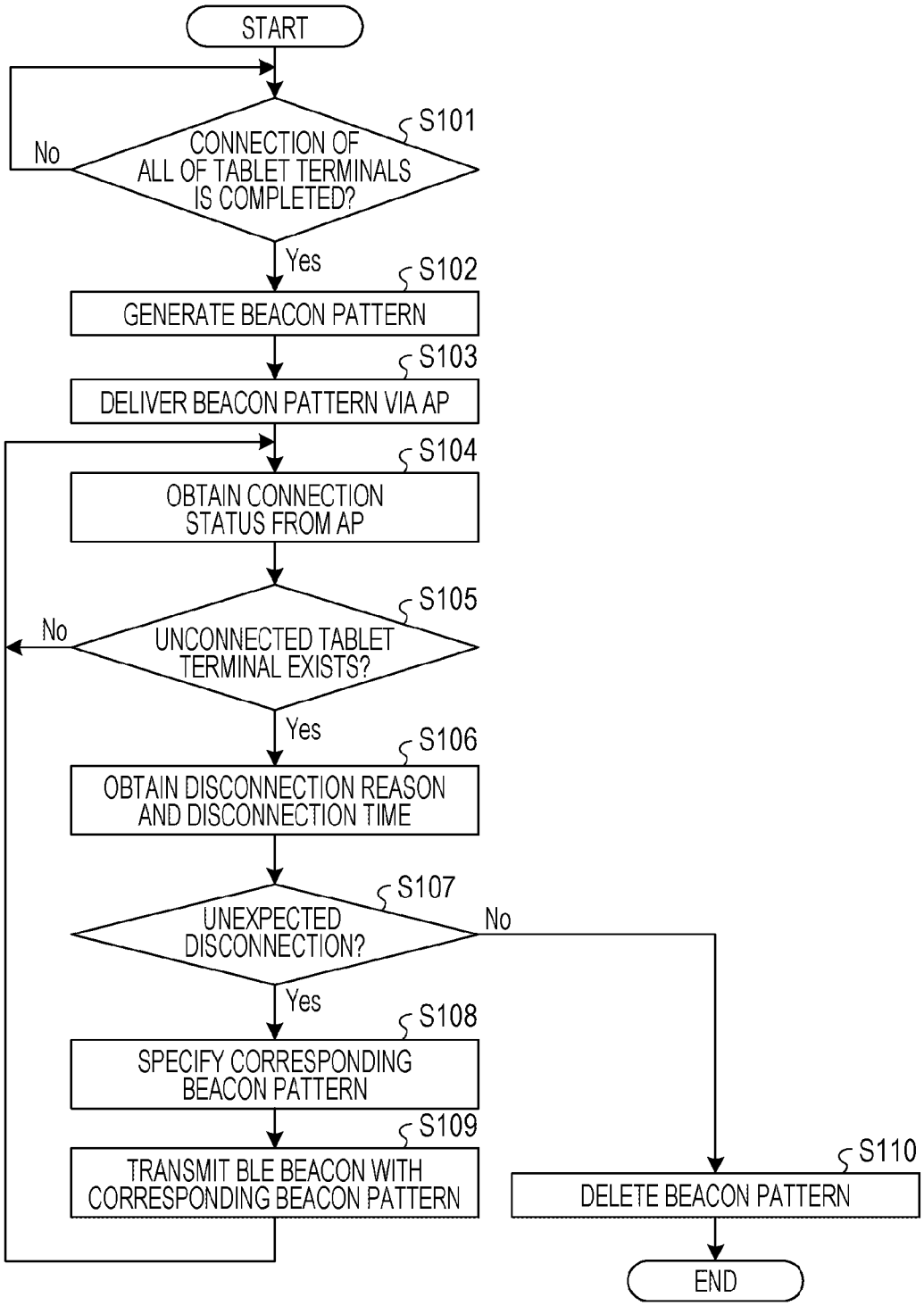

START
S101
CONNECTION OF ALL OF TABLET TERMINALS IS COMPLETED?
No
Yes
S102
GENERATE BEACON PATTERN
S103
DELIVER BEACON PATTERN VIA AP
S104
OBTAIN CONNECTION STATUS FROM AP
S105
UNCONNECTED TABLET TERMINAL EXISTS?
No
Yes
S106
OBTAIN DISCONNECTION REASON AND DISCONNECTION TIME
S107
UNEXPECTED DISCONNECTION?
No
Yes
S108
SPECIFY CORRESPONDING BEACON PATTERN
S109
TRANSMIT BLE BEACON WITH CORRESPONDING BEACON PATTERN
S110
DELETE BEACON PATTERN
END

FIG. 7

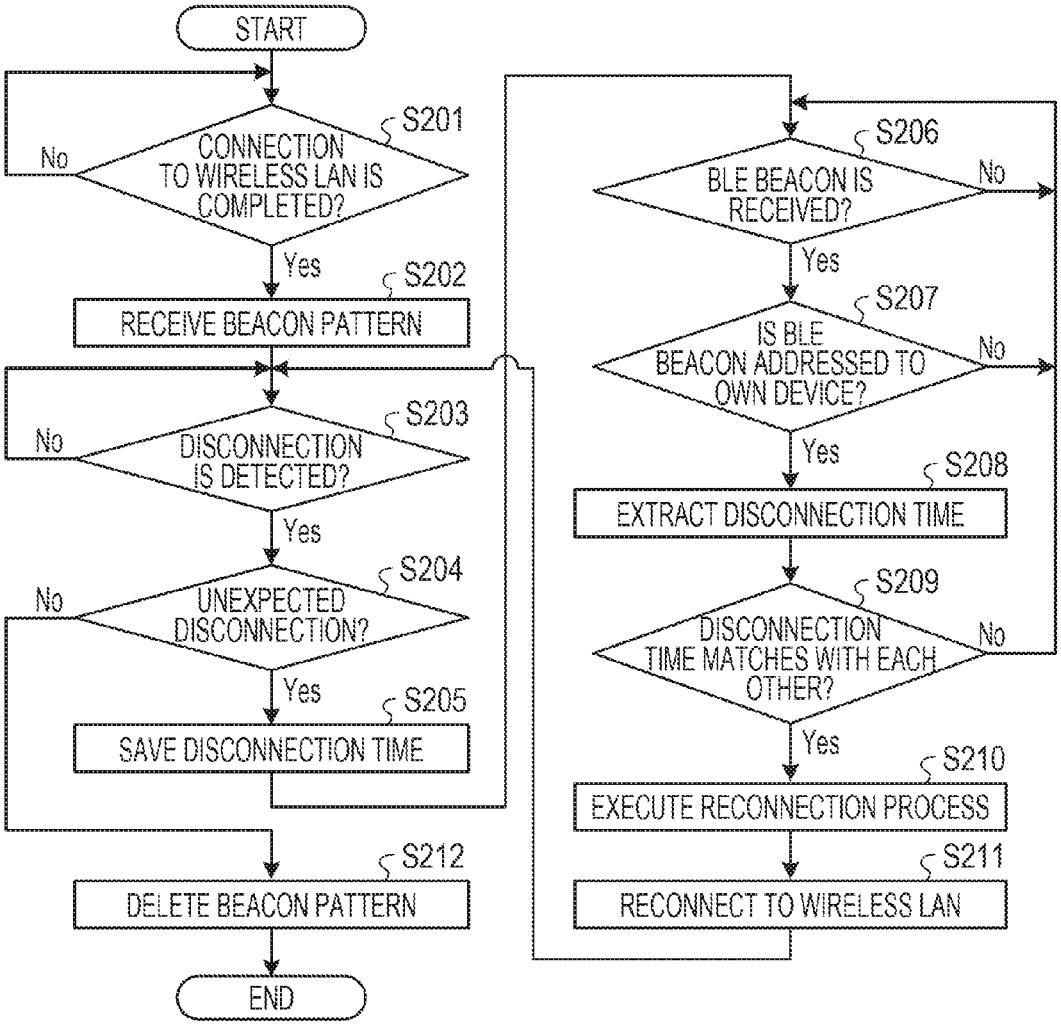

START
S201
CONNECTION TO WIRELESS LAN IS COMPLETED?
No
Yes
S202
RECEIVE BEACON PATTERN
S203
DISCONNECTION IS DETECTED?
No
Yes
S204
UNEXPECTED DISCONNECTION?
No
Yes
S205
SAVE DISCONNECTION TIME
S212
DELETE BEACON PATTERN
END
S206
BLE BEACON IS RECEIVED?
No
Yes
S207
IS BLE BEACON ADDRESSED TO OWN DEVICE?
No
Yes
S208
EXTRACT DISCONNECTION TIME
S209
DISCONNECTION TIME MATCHES WITH EACH OTHER?
No
Yes
S210
EXECUTE RECONNECTION PROCESS
S211
RECONNECT TO WIRELESS LAN

FIG. 8

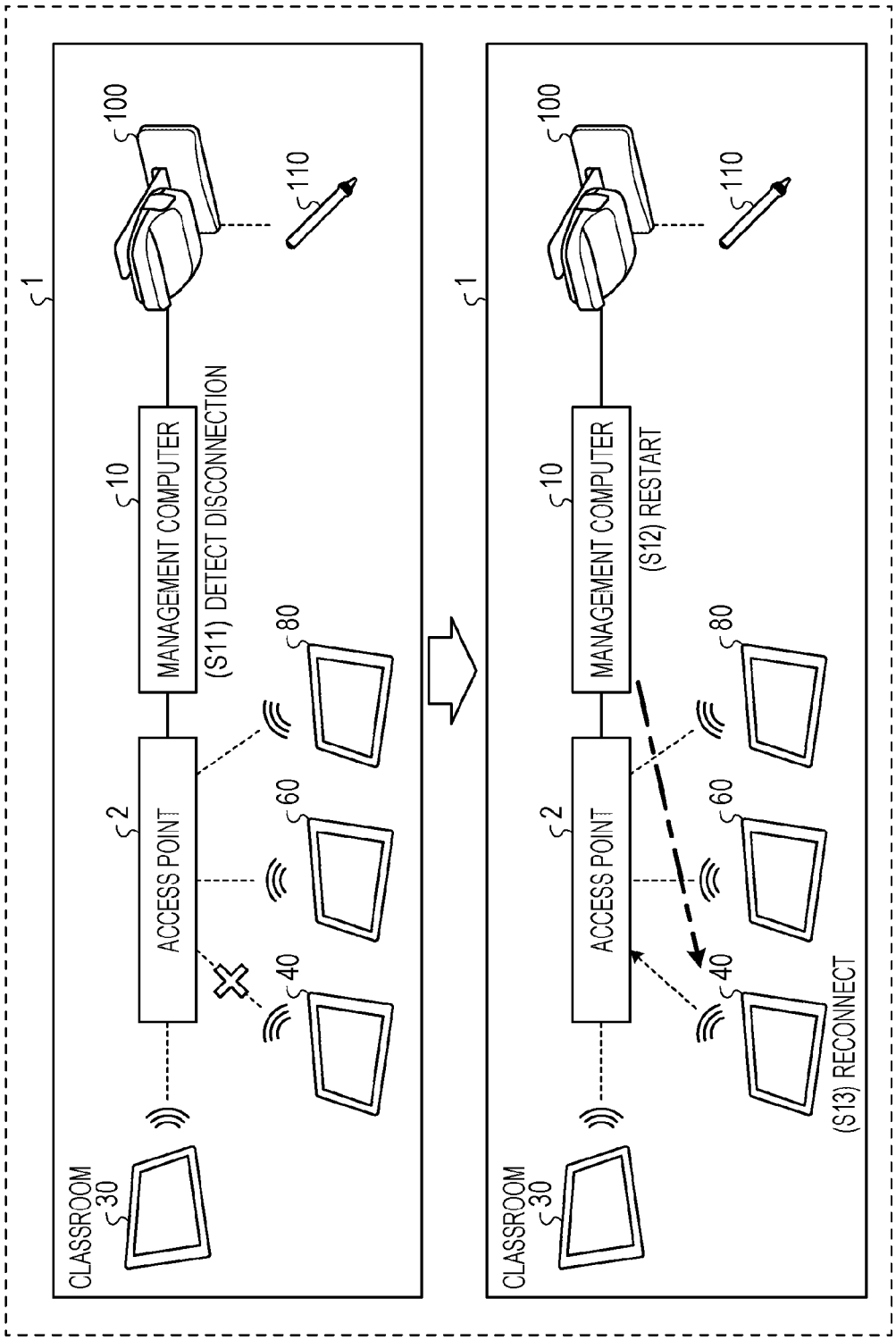

1
100
110
10
MANAGEMENT COMPUTER
(S11) DETECT DISCONNECTION
2
ACCESS POINT
80
60
40
CLASSROOM
30
1
100
110
10
MANAGEMENT COMPUTER
(S12) RESTART
2
ACCESS POINT
80
60
40
(S13) RECONNECT
CLASSROOM
30

FIG. 9

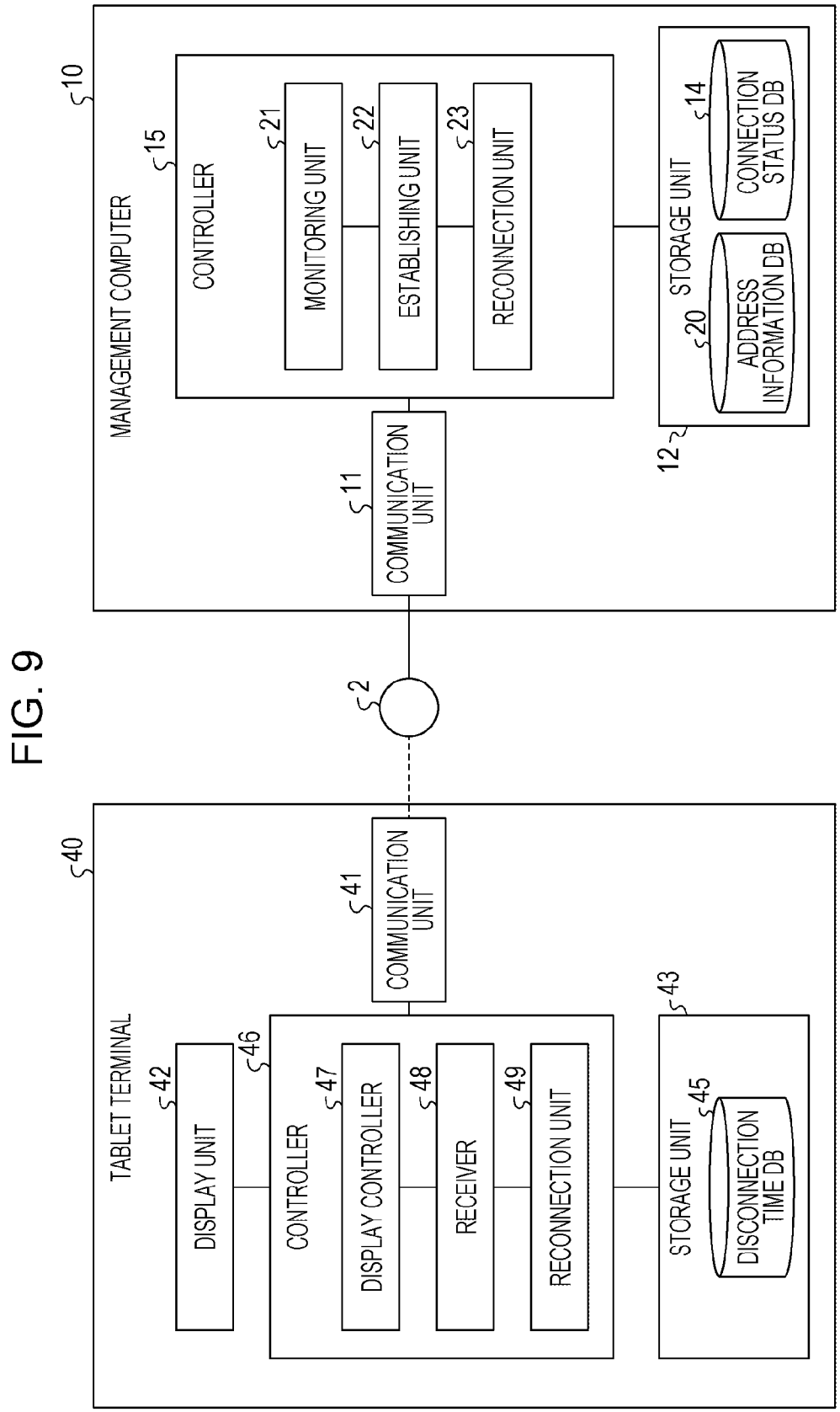

10
MANAGEMENT COMPUTER
15
CONTROLLER
21
MONITORING UNIT
22
ESTABLISHING UNIT
23
RECONNECTION UNIT
11
COMMUNICATION UNIT
12
STORAGE UNIT
14
CONNECTION STATUS DB
20
ADDRESS INFORMATION DB
2
40
TABLET TERMINAL
41
COMMUNICATION UNIT
42
DISPLAY UNIT
46
CONTROLLER
47
DISPLAY CONTROLLER
48
RECEIVER
49
RECONNECTION UNIT
43
STORAGE UNIT
45
DISCONNECTION TIME DB

FIG. 10

TABLET TERMINAL	MAC ADDRESS	BD ADDRESS
STUDENT A	A1:B2:C3:F3:E2:D1	B1:C2:D3:G3:F2:E1
STUDENT B	A1:B2:C3:F3:E2:D2	B1:C2:D3:G3:F2:E2
STUDENT C	A1:B2:C3:F3:E2:D3	B1:C2:D3:G3:F2:E3
STUDENT D	A1:B2:C3:F3:E2:D4	B1:C2:D3:G3:F2:E4
STUDENT E	A1:B2:C3:F3:E2:D5	B1:C2:D3:G3:F2:E5
STUDENT F	A1:B2:C3:F3:E2:D6	B1:C2:D3:G3:F2:E6
STUDENT G	A1:B2:C3:F3:E2:D7	B1:C2:D3:G3:F2:E7
STUDENT H	A1:B2:C3:F3:E2:D8	B1:C2:D3:G3:F2:E8
STUDENT I	A1:B2:C3:F3:E2:D9	B1:C2:D3:G3:F2:E9
STUDENT J	A1:B2:C3:F3:E2:DA	B1:C2:D3:G3:F2:EA
STUDENT K	A1:B2:C3:F3:E2:DB	B1:C2:D3:G3:F2:EB
STUDENT L	A1:B2:C3:F3:E2:DC	B1:C2:D3:G3:F2:EC
STUDENT M	A1:B2:C3:F3:E2:DD	B1:C2:D3:G3:F2:ED
STUDENT O	A1:B2:C3:F3:E2:DE	B1:C2:D3:G3:F2:EE
STUDENT P	A1:B2:C3:F3:E2:DF	B1:C2:D3:G3:F2:EF
STUDENT Q	A1:B2:C3:F3:E2:E0	B1:C2:D3:G3:F2:F0
STUDENT R	A1:B2:C3:F3:E2:E1	B1:C2:D3:G3:F2:F1
STUDENT S	A1:B2:C3:F3:E2:E2	B1:C2:D3:G3:F2:F2
STUDENT T	A1:B2:C3:F3:E2:E3	B1:C2:D3:G3:F2:F3
STUDENT U	A1:B2:C3:F3:E2:E4	B1:C2:D3:G3:F2:F4
STUDENT V	A1:B2:C3:F3:E2:E5	B1:C2:D3:G3:F2:F5
STUDENT W	A1:B2:C3:F3:E2:E6	B1:C2:D3:G3:F2:F6
STUDENT X	A1:B2:C3:F3:E2:E7	B1:C2:D3:G3:F2:F7
STUDENT Y	A1:B2:C3:F3:E2:E8	B1:C2:D3:G3:F2:F8
STUDENT Z	A1:B2:C3:F3:E2:E9	B1:C2:D3:G3:F2:F9
STUDENT α	A1:B2:C3:F3:E2:EA	B1:C2:D3:G3:F2:FA
STUDENT β	A1:B2:C3:F3:E2:EB	B1:C2:D3:G3:F2:FB

FIG. 11

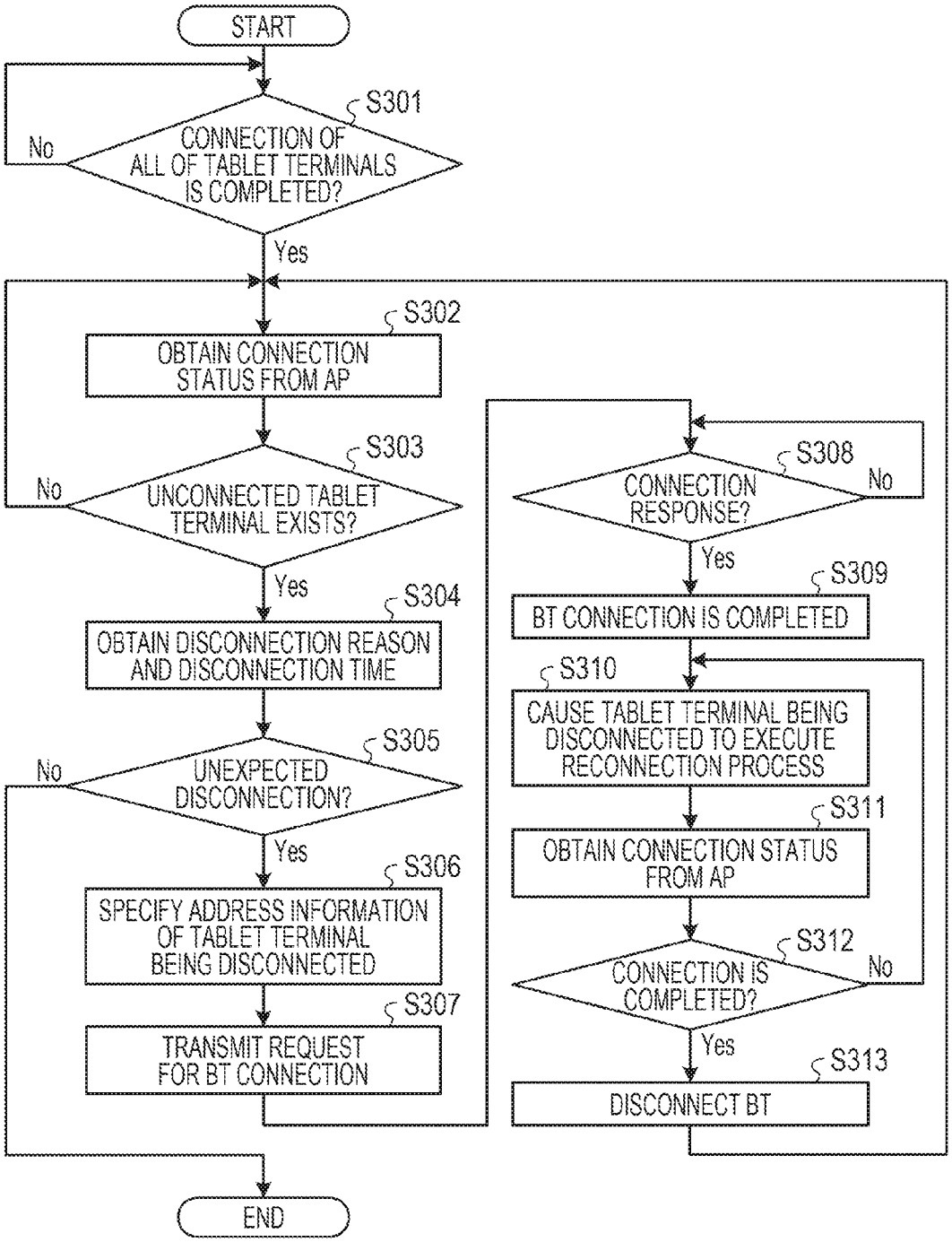

START
S301
CONNECTION OF ALL OF TABLET TERMINALS IS COMPLETED?
No
Yes
S302
OBTAIN CONNECTION STATUS FROM AP
S303
UNCONNECTED TABLET TERMINAL EXISTS?
No
Yes
S304
OBTAIN DISCONNECTION REASON AND DISCONNECTION TIME
S305
UNEXPECTED DISCONNECTION?
No
Yes
S306
SPECIFY ADDRESS INFORMATION OF TABLET TERMINAL BEING DISCONNECTED
S307
TRANSMIT REQUEST FOR BT CONNECTION
END
S308
CONNECTION RESPONSE?
No
Yes
S309
BT CONNECTION IS COMPLETED
S310
CAUSE TABLET TERMINAL BEING DISCONNECTED TO EXECUTE RECONNECTION PROCESS
S311
OBTAIN CONNECTION STATUS FROM AP
S312
CONNECTION IS COMPLETED?
No
Yes
S313
DISCONNECT BT

FIG. 12

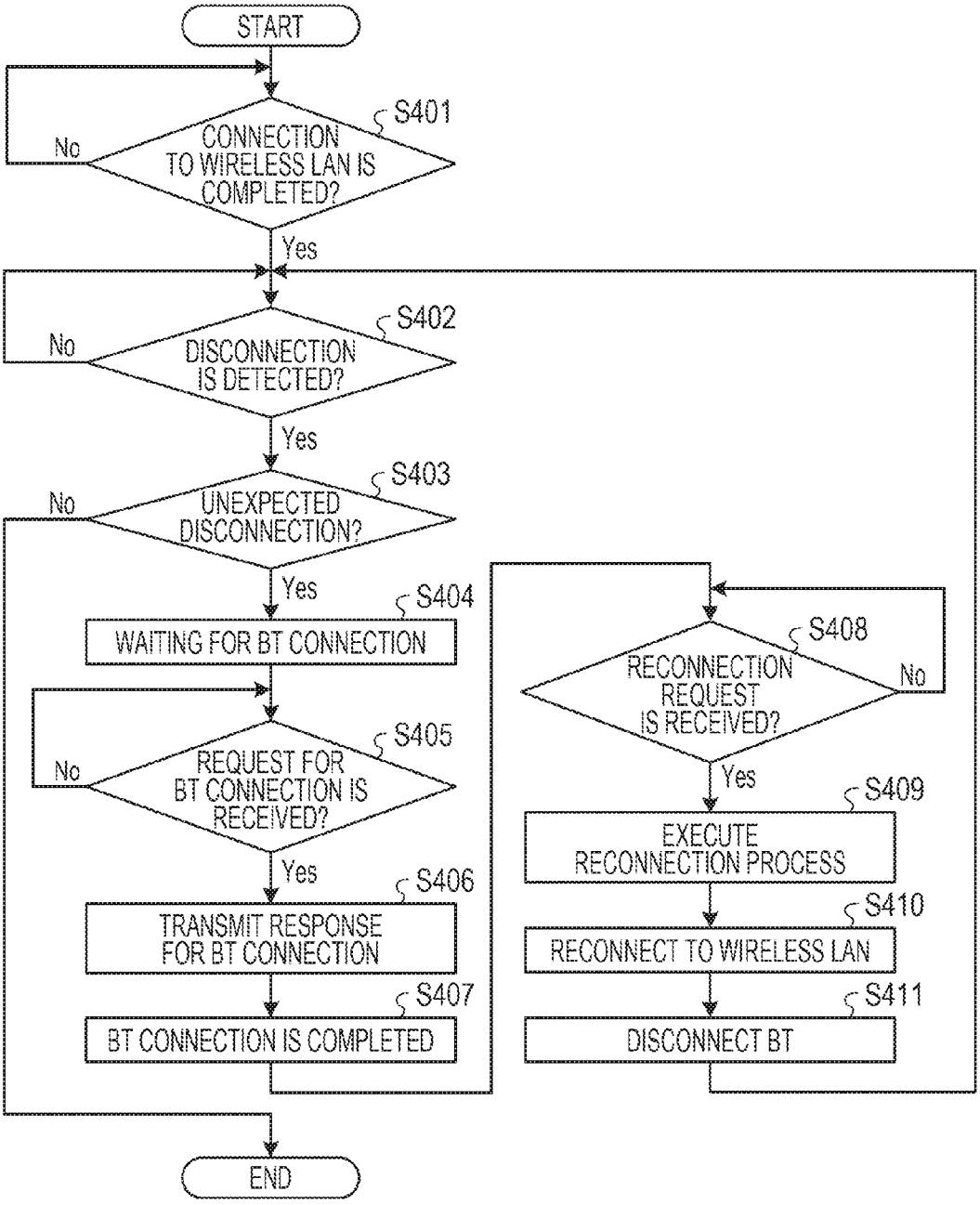

START
S401
CONNECTION TO WIRELESS LAN IS COMPLETED?
No
Yes
S402
DISCONNECTION IS DETECTED?
No
Yes
S403
UNEXPECTED DISCONNECTION?
No
Yes
S404
WAITING FOR BT CONNECTION
S405
REQUEST FOR BT CONNECTION IS RECEIVED?
No
Yes
S406
TRANSMIT RESPONSE FOR BT CONNECTION
S407
BT CONNECTION IS COMPLETED
S408
RECONNECTION REQUEST IS RECEIVED?
No
Yes
S409
EXECUTE RECONNECTION PROCESS
S410
RECONNECT TO WIRELESS LAN
S411
DISCONNECT BT
END

FIG. 13

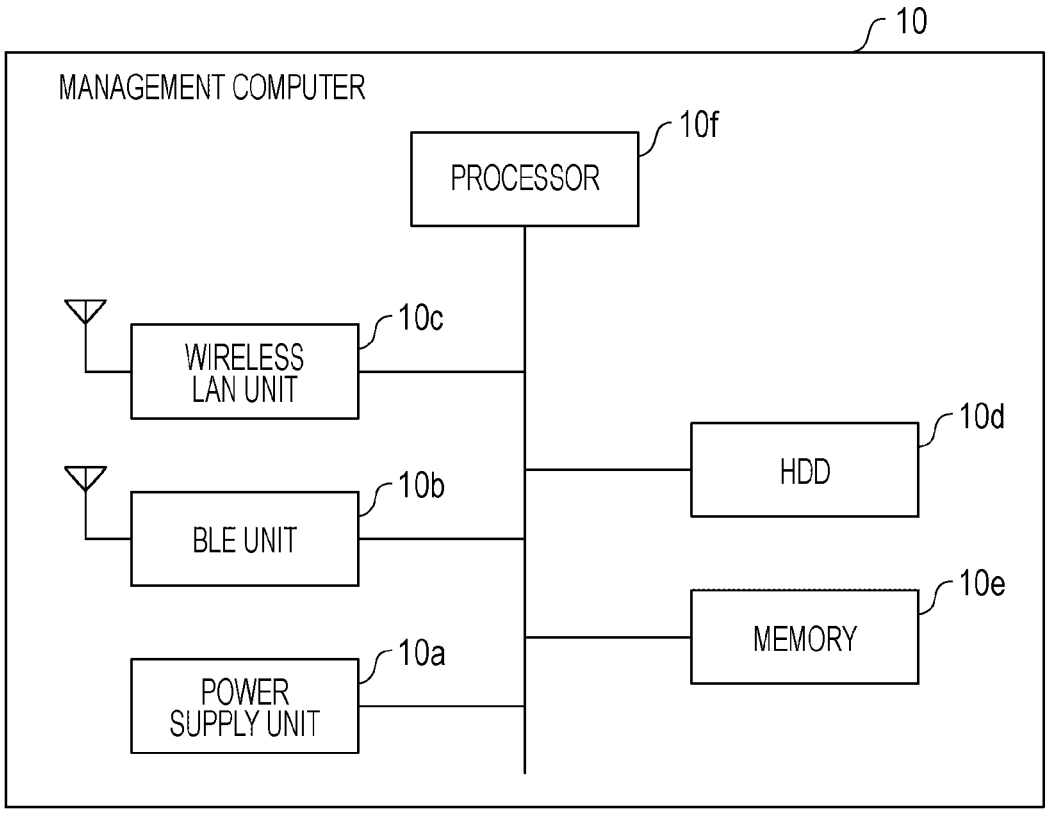
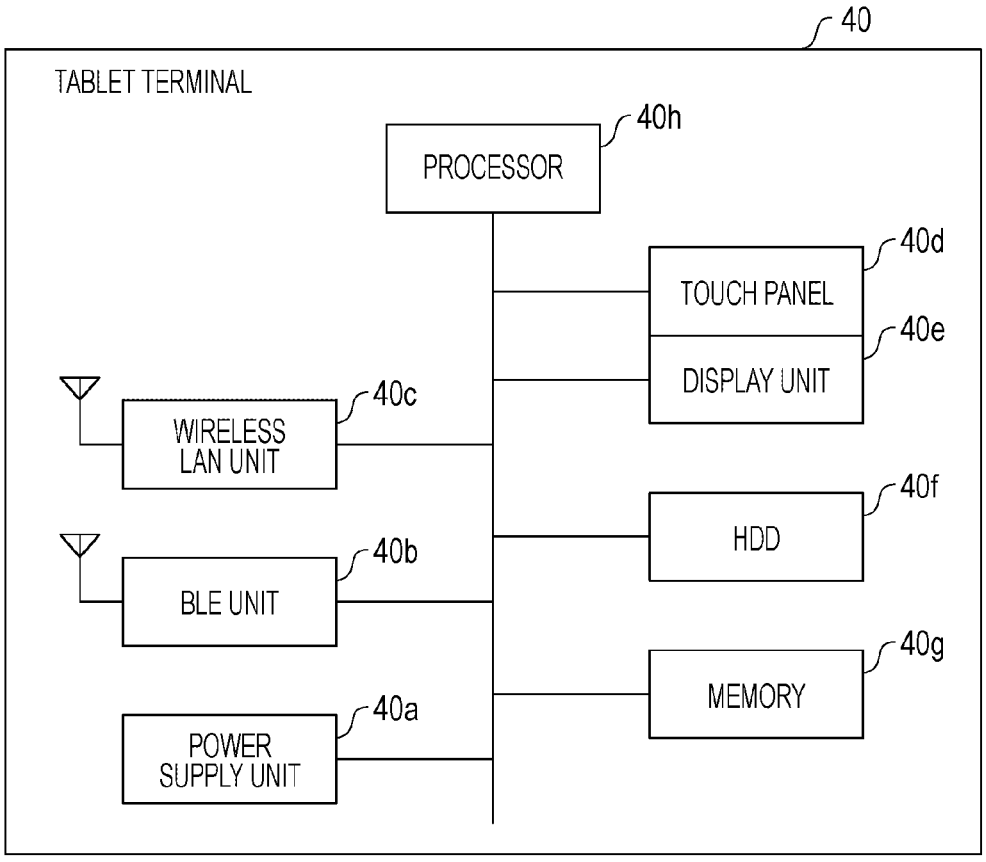

10
MANAGEMENT COMPUTER
PROCESSOR
10f
WIRELESS LAN UNIT
10c
BLE UNIT
10b
POWER SUPPLY UNIT
10a
HDD
10d
MEMORY
10e

FIG. 14


40
TABLET TERMINAL
PROCESSOR
40h
TOUCH PANEL
40d
DISPLAY UNIT
40e
WIRELESS LAN UNIT
40c
BLE UNIT
40b
HDD
40f
MEMORY
40g
POWER SUPPLY UNIT
40a

APPARATUS AND METHOD TO CONTROL RECONNECTION OF A TERMINAL DEVICE TO A WIRELESS NETWORK VIA ANOTHER WIRELESS NETWORK

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2016-194718, filed on Sep. 30, 2016, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The embodiments discussed herein are related to apparatus and method to control reconnection of a terminal device to a wireless network via another wireless network.

BACKGROUND

[0003] According to a promotion of information and communication technology (ICT) education by government policy, for elementary and junior high schools all over the country, one tablet computer (hereinafter, may be referred to as "tablet") per 3.6 students is deployed by the year 2017 and one per one student is deployed by the year 2020, and an achievement rate of 100% in maintenance of a wireless local area network (LAN) is planned.

[0004] In this way, although ICT education has been gradually processed at each of schools, even now, there are schools which provide classes with a digital textbook by deploying an electronic blackboard, a wireless LAN access point (hereinafter, may be referred to as "AP"), a tablet for teacher, and a tablet for student in each of classrooms. In recent years, a technology in which when a terminal device such as a tablet or the like is coupled to another terminal device via a wireless LAN and disconnection from the wireless LAN is detected, a user performs a connection procedure with a wired LAN is known.

[0005] Japanese Laid-open Patent Publication No. 2005-175814 is an example of the related art.

SUMMARY

[0006] According to an aspect of the invention, an apparatus obtains connection status information of each of terminal devices coupled to a first wireless network via an access point, from the access point. The apparatus detects a disconnected device which is a terminal device whose communication with the access point is disconnected, with reference to the connection status information, and notifies, via a second wireless network, the disconnected device of a reconnection instruction for instructing the disconnected device to reconnect to the first wireless network by accessing the access point.

[0007] The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims.

[0008] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. **1** is a diagram illustrating an example of an overall configuration of a system, according to an embodiment;

[0010] FIG. **2** is a diagram illustrating an example of a functional configuration of each of devices, according to an embodiment;

[0011] FIG. **3** is a diagram illustrating an example of information stored in a beacon pattern database (DB), according to an embodiment;

[0012] FIG. **4** is a diagram illustrating an example of information stored in a connection status DB, according to an embodiment;

[0013] FIG. **5** is a diagram illustrating an example of automatic recovery, according to an embodiment;

[0014] FIG. **6** is a diagram illustrating an example of an operational flowchart for a process of a management computer, according to an embodiment;

[0015] FIG. **7** is a diagram illustrating an example of an operational flowchart for a process of a tablet terminal, according to an embodiment;

[0016] FIG. **8** is a diagram illustrating an example of automatic recovery, according to an embodiment;

[0017] FIG. **9** is a diagram illustrating an example of a functional configuration of each of devices, according to an embodiment;

[0018] FIG. **10** is a diagram illustrating an example of information stored in an address information DB, according to an embodiment;

[0019] FIG. **11** is a diagram illustrating an example of an operational flowchart for a process of a management computer, according to an embodiment;

[0020] FIG. **12** is a diagram illustrating an example of an operational flowchart for a process of a tablet terminal, according to an embodiment;

[0021] FIG. **13** is a diagram illustrating an example of a hardware configuration of a management computer, according to an embodiment; and

[0022] FIG. **14** is a diagram illustrating an example of a hardware configuration of a tablet terminal, according to an embodiment.

DESCRIPTION OF EMBODIMENTS

[0023] Since elementary school students generally do not have high information Technology (IT) literacy, it is difficult to reconnect terminal devices disconnected from a wireless network to a wired network or a wireless network. For this reason, since a teacher manually restores the terminal, the teacher stops the class and restores the terminal device and a progress of the class is hindered every time disconnection of the terminal device occurs. In addition, in a case where the teacher's IT literacy is low, a stop time of the class will be even longer.

[0024] It is also conceivable that a tablet terminal has a function of constantly monitoring communication with AP, and a function of executing restarting of an operating system (OS) of the tablet and executing AP reconnection when detecting disconnection. However, since tablet terminals are equipped with processors with lower performance than general personal computers, a screen display or the like is delayed when these functions are included.

[0025] It is preferable to automatically reconnect a terminal device disconnected from a wireless network, with the wireless network.

[0026] Hereinafter, examples of a monitoring device, a reconnection method, and a reconnection program disclosed in the present application will be described in detail with reference to drawings. The embodiment is not limited by this example. In addition, each of the examples can be appropriately combined within a range without contradiction.

EXAMPLE 1

[0027] Overall Configuration Example

[0028] FIG. **1** is a diagram illustrating an overall configuration example of a system according to Example 1. In Example 1, as an example, a school class or the like is assumed. For example, a wireless LAN is built in a classroom, tablet terminals are distributed to each student and teacher, and a class is held by displaying information such as a textbook on the tablet terminals by using the wireless LAN.

[0029] FIG. **1** illustrates a classroom **1** and a server **120** installed outside the classroom **1**. In the classroom **1**, a wireless LAN such as a Wireless-Fidelity (Wi-Fi)® is built and the classroom **1** includes an access point **2**, a management computer **10**, a tablet terminal **30** for teacher, tablet terminals **40**, **60**, and **80** for students, an electronic blackboard projector **100**, and an electronic pen **110**.

[0030] The access point **2** is an example of a device which connects each of tablet terminals in the classroom **1** to a wireless LAN and connects the external server **120** to the wireless LAN in the classroom **1**, and is generally a computer such as a router, a station, for example.

[0031] The tablet terminal **30** for teacher and the tablet terminals **40**, **60**, and **80** for students are examples of portable mobile terminals and are computers having a touch panel, a wireless connection function, and the like. These tablet terminals are equipped with processors having lower performance than an ordinary personal computer for the purpose of reducing the thickness and weight, and the battery operation.

[0032] In addition, these tablet terminals are coupled to a wireless LAN via the access point **2** and are coupled to each other so as to communicate with each other. Further, each of the tablet terminals is coupled to the external server **120** via the access point **2**. Each of the tablet terminals displays textbook data delivered from the management computer **10** or the server **120**. Here, a class is held using textbook data instead of an ordinary textbook.

[0033] The management computer **10** is an example of a computer such as a monitoring device and is coupled to the access point **2** via a wireless LAN or a wired line. The management computer **10** obtains textbook data from the server **120** via the access point **2** and delivers the data to each of the tablet terminals coupled to a wireless LAN via the access point **2**.

[0034] For example, the electronic blackboard projector **100** is coupled to the management computer **10** via a wired line such as a High-Definition Multimedia Interface (HDMI)®. The electronic blackboard projector **100** projects various images and videos input from the management computer **10** on a screen. In addition, the electronic blackboard projector **100** is coupled to the electronic pen **110** via infrared rays or the like and projects operation information by the electronic pen **110** on the screen together with various images and videos input from the management computer **10**.

[0035] The server **120** is an example of an external server which is coupled to the access point **2** and holds textbook data. Upon receiving a request for data acquisition from each of the tablet terminals or the management computer **10**, the server **120** transmits the textbook data to a request destination via the access point **2**.

[0036] In this way, in a state in which the tablet terminal **30** for teacher and the tablet terminals **40**, **60**, and **80** for students are coupled to a wireless LAN via the access point **2**, the management computer **10** obtains, from the access point **2**, connection status of each of the tablet terminals coupled to a wireless LAN via the access point **2**. With reference to the connection status, the management computer **10** detects a tablet terminal (hereinafter, sometimes described as "disconnected tablet") disconnected from communication with the access point **2**. Thereafter, the management computer **10** notifies, by using a Bluetooth® Low Energy (BLE) beacon, the disconnected tablet being disconnected from a wireless LAN of a reconnection instruction for instructing the disconnected tablet to reconnect with a wireless LAN by accessing the access point **2**.

[0037] Therefore, upon detecting a tablet for student disconnected from a wireless LAN in a classroom during a class, the management computer **10** transmits the reconnection instruction for reconnection with a wireless LAN, by using a BLE beacon. As a result, the tablet terminal disconnected from a wireless LAN may automatically reconnect with a wireless LAN without a teacher or a student performing recovery operation.

[0038] Functional Configuration

[0039] Next, functional configurations of devices illustrated in FIG. **1** will be described. Here, functional configurations of the management computer **10** and each of the tablet terminals, which have functions different from a general device, will be described. Since each of the tablet terminals has the same configuration, the tablet terminal **40** will be described as an example.

[0040] Functional Configuration of Management Computer **10**

[0041] FIG. **2** is a functional block diagram illustrating a functional configuration of each of devices according to Example 1. As illustrated in FIG. **2**, the management computer **10** includes a communication unit **11**, a storage unit **12**, and a controller **15**.

[0042] The communication unit **11** is a processing unit which controls various communications such as a wireless communication or a wire communication. For example, the communication unit **11** is coupled to a wireless LAN via the access point **2**, transmits information to each of the tablet terminals in a wireless LAN, and receives various kinds of information from each of the tablet terminals. For example, the communication unit **11** receives connection status from the access point **2** and transmits textbook data to each of the tablet terminals. In addition, the communication unit **11** executes transmission control of a BLE beacon or the like.

[0043] The storage unit **12** is a storage device which stores a program executed by the controller **15** or various kinds of data and is, for example, a memory or a hard disk. The storage unit **12** stores a beacon pattern DB **13** or a connection status DB **14**.

[0044] The beacon pattern DB **13** is a database storing a beacon pattern which is a combination of channels of

transmission frequencies of a BLE beacon. For example, the beacon pattern DB **13** is a combination of advertising channels used in the BLE beacon and stores identification information used for identifying a tablet terminal of each student.

[0045] FIG. **3** is a diagram illustrating an example of information stored in the beacon pattern DB **13**. As illustrated in FIG. **3**, the beacon pattern DB **13** stores "tablet terminal", "media access control (MAC) address", and "transmission channel (first time, second time, and third time)" in association with each other. "tablet terminal" is a name of a tablet terminal used by a student, and "MAC address" is a MAC address of the tablet terminal for each student. "transmission channel" is channel information of an advertising channel, and "first time", "second time", and "third time" are advertising channels used by a BLE beacon.

[0046] In the example in FIG. **3**, in a case of transmitting an instruction to a tablet terminal of a student A of which a MAC address is "A1:B2:C3:F3:E2:D1", "37 ch" is used for the first time, "37 ch" is used for the second time, and "37 ch" is used for the third time. In this way, by a combination of advertising channels (37 ch, 38 ch, and 39 ch), each of the tablet terminals is identified. The combination of advertising channels may be changed for each of classes. In addition, in FIG. **3**, a tablet terminal for teacher is excluded from a management target, but the tablet terminal for teacher may be included in the management target in the same manner as a tablet terminal for student.

[0047] The connection status DB **14** is a database which stores connection status of each of the tablet terminals coupled to a wireless LAN. Information stored here may be collected by the access point **2**.

[0048] FIG. **4** is a diagram illustrating an example of information stored in the connection status DB **14**. As illustrated in FIG. **4**, the connection status DB **14** stores "tablet terminal", "MAC address", "status", "disconnection time", and "disconnection reason" in association with each other. Here, "tablet terminal" is a name of a tablet terminal used by a student, and "MAC address" is a MAC address of the tablet terminal for each student. "tablet terminal" and "MAC address" may be preset.

[0049] "status" indicates connection status and stores "connecting" or "unconnected". "disconnection time" is disconnected time. "disconnection reason" indicates whether or not a tablet terminal is disconnected during a class, and is set at "unexpected disconnection" in a case where the tablet terminal is disconnected during the class. "disconnection reason" may be determined by the access point **2** or the management computer **10**.

[0050] FIG. **4** illustrates that in a tablet terminal of a student C of which a MAC address is "A1:B2:C3:F3:E2:D3", "unexpected disconnection" occurs at "9:45" and the other tablet terminals of the other students are normally connected.

[0051] The controller **15** is a processing unit which manages whole of the management computer **10** and is, for example, a processor or the like. The controller **15** includes a pattern generating unit **16**, a delivering unit **17**, a monitoring unit **18**, and an instruction notification unit **19**. The pattern generating unit **16**, the delivering unit **17**, the monitoring unit **18**, and the instruction notification unit **19** are an example of an electronic circuit included in a processor or the like or an example of a process executed by the processor.

[0052] The pattern generating unit **16** is a processing unit which generates a combination of advertising channels for identifying each of the tablet terminals. For example, the pattern generating unit **16** generates a beacon pattern illustrated in FIG. **3**, and saves the beacon pattern in the beacon pattern DB **13** at a class start time. In addition, the pattern generating unit **16** also may delete information stored in the beacon pattern DB **13** at a class end time. The class start time or the class end time may be preset. In addition, as a generating method, it is possible to adopt a BLE random address setting and the like, and to arbitrarily change a combination of channels or the number of times of transmission, depending on the number of tablet terminals.

[0053] The delivering unit **17** is a processing unit which delivers the beacon pattern generated by the pattern generating unit **16** to each of the tablet terminals via a wireless LAN. For example, when a beacon pattern is saved in the beacon pattern DB **13**, the delivering unit **17** reads the beacon pattern from the beacon pattern DB **13** and transmits the beacon pattern, via the access point **2**, to each of the tablet terminals by using "MAC address" stored in advance in the connection status DB **14**.

[0054] The monitoring unit **18** is a processing unit which monitors connection status of a tablet terminal to a wireless LAN for each student. For example, the monitoring unit **18** obtains connection status (status, disconnection time, and the like) from the access point **2**, and monitors whether or not unexpected disconnection occurs. For example, the monitoring unit **18** regularly obtains connection status from the access point **2** and saves the obtained connection status in the connection status DB **14**. Then, in a case of detecting status "unconnected" during a class, the monitoring unit **18** sets "unexpected disconnection" to "disconnection reason" for a tablet terminal from which status "unconnected" has been detected.

[0055] The instruction notification unit **19** is a processing unit which notifies a tablet terminal to which "unexpected disconnection" is set by the monitoring unit **18**, by using BLE different from a wireless LAN, of an instruction for reconnection to a wireless LAN by accessing the access point **2**. For example, the instruction notification unit **19** specifies a combination of transmission channels corresponding to a tablet terminal for student in a disconnected state, from the beacon pattern DB **13**, and broadcasts an instruction for reconnection by using the specified combination.

[0056] For example, upon detecting that "unexpected disconnection" is set to a tablet terminal of the student C with reference to the connection status DB **14**, the instruction notification unit **19** obtains disconnection time "9:45" from the connection status DB **14**. Next, the instruction notification unit **19** obtains transmission channels (37 ch, 37 ch, and 39 ch) of the tablet terminal of the student C in a disconnected state, from the beacon pattern DB **13**. Then, the instruction notification unit **19** broadcasts an advertised packet including time information "9:45" which is disconnection time, as a BLE beacon via 37 ch. After a predetermined time (for example, 30 seconds), the instruction notification unit **19** broadcasts an advertised packet including time information "9:45" as a BLE beacon via 37 ch. Further, after a predetermined time (for example, 30 seconds), the instruction notification unit **19** broadcasts an advertised packet including time information "9:45" as a BLE beacon via 39 ch.

[0057] That is, by notifying a BLE beacon three times for one disconnection detection, it is possible to notify disconnection time to the tablet terminal of the student C in a disconnected state. The BLE beacon may include a reconnection instruction, a reconnection command, or the like. The predetermined time may be arbitrarily changed.

[0058] In this way, by broadcasting packet data with a combination of three frequency channels, it is possible to identify a tablet terminal for student. In addition, since Bluetooth® device address (BD address), which may be an attack target when acquired by a third party, is not included in the beacon, security is high and risk of becoming the attack target of the third party becomes also small.

[0059] In addition, in a case where a disconnected tablet terminal is detected and nothing is registered as a disconnection reason, that is, "unexpected disconnection" is not registered as a disconnection reason, the instruction notification unit **19** determines that a class is ended and deletes a beacon pattern stored in the beacon pattern DB **13**.

[0060] Functional Configuration of Tablet Terminal **40**

[0061] As illustrated in FIG. **2**, the tablet terminal **40** includes a communication unit **41**, a display unit **42**, a storage unit **43**, and a controller **46**.

[0062] The communication unit **41** is a processing unit which is coupled to a wireless LAN via the access point **2** and controls communication with another tablet terminal, the management computer **10**, the server **120**, and the like. For example, the communication unit **41** receives textbook data from the management computer **10** via the access point **2**.

[0063] In addition, the communication unit **41** receives a BLE beacon broadcasted from the management computer **10**. For example, the communication unit **41** receives an advertised packet including time information and the like from the management computer **10** without going through the access point **2**.

[0064] The display unit **42** is a touch panel display which displays each piece of information and accepts operation of a student or the like. For example, the display unit **42** displays textbook data and accepts page turning operation, answer operation to a problem, or the like.

[0065] The storage unit **43** is a storage device which stores a program executed by the controller **46** or various kinds of data and is, for example, a memory or a hard disk. The storage unit **43** stores a beacon pattern DB **44** and a disconnection time DB **45**.

[0066] The beacon pattern DB **44** is a database which stores a beacon pattern which is a combination of transmission frequency channels of a BLE beacon. For example, the beacon pattern DB **44** stores a beacon pattern delivered from the management computer **10**. The stored information is the same as in FIG. **3**, and a detailed description thereof will be omitted.

[0067] The disconnection time DB **45** is a database which stores a time at which the tablet terminal **40** is disconnected from a wireless LAN. For example, the disconnection time DB **45** stores disconnection time "9:45" and the like. Here, the stored disconnection time is the latest disconnection time and is updated by the controller **46**.

[0068] The controller **46** is a processing unit which manages the overall tablet terminal **40** and is, for example, a processor or the like. The controller **46** includes a display controller **47**, a receiver **48**, and a reconnection unit **49**. The display controller **47**, the receiver **48**, and the reconnection unit **49** are an example of an electronic circuit included in a processor or the like or an example of a process executed by the processor.

[0069] Upon detecting a tablet disconnected from a wireless LAN, the controller **46** determines whether or not disconnected time is in a time zone designated in advance such as a time zone in which a class is ended. In a case where the disconnected time is not in the time zone designated in advance, the controller **46** makes a determination of unexpected disconnection and saves the disconnection time in the disconnection time DB **45**. On the other hand, in a case where the disconnected time is in the time zone designated in advance, the controller **46** makes a determination of a class being ended and deletes information stored in the beacon pattern DB **44**.

[0070] The display controller **47** is a processing unit which executes an information display or touch panel operation. For example, the display controller **47** displays textbook data received from the management computer **10** on the display unit **42**. In addition, the display controller **47** accepts touch panel operation via the display unit **42** and executes a process corresponding to the accepted touch panel operation. For example, the display controller **47** executes page turning when swipe operation is accepted and executes an enlarged display when receiving double click operation.

[0071] The receiver **48** is a processing unit which receives a beacon pattern delivered from the management computer **10**. For example, the receiver **48** receives a beacon pattern from the management computer **10** via the access point **2** and saves the beacon pattern in the beacon pattern DB **44**.

[0072] The reconnection unit **49** is a processing unit which executes reconnection to a wireless LAN according to a reconnection instruction from the management computer **10**. For example, the reconnection unit **49** receives a BLE beacon with a beacon pattern assigned to the tablet terminal **40** and executes reconnection in a case where disconnection time notified with the received BLE beacon matches with disconnection time stored in the disconnection time DB **45**.

[0073] For example, a case where the tablet terminal **40** is a tablet terminal of the student C will be described. The reconnection unit **49** specifies that a beacon pattern assigned to the tablet terminal **40** is 37 ch, 37 ch, and 39 ch with reference to the beacon pattern DB **44**. Thereafter, the reconnection unit **49** receives an advertised packet of a BLE beacon broadcasted from the management computer **10** via 37 ch, subsequently receives an advertised packet of a BLE beacon broadcasted via 37 ch, and lastly receives an advertised packet of a BLE beacon broadcasted via 39 ch.

[0074] Then, since the respective channels used by the management computer **10** are equal to a beacon pattern (37 ch, 37 ch, and 39 ch) of the tablet terminal **40**, the reconnection unit **49** determines that the advertised packets are addressed to the tablet terminal **40**. The reconnection unit **49** extracts time information from each of the received three advertised packets, and restarts the tablet terminal **40** and reconnects to a wireless LAN in a case where each piece of time information is equal to disconnection time (9:45) stored in the disconnection time DB **45**. A reconnection process is not limited to rebooting but can also include executing a command and the like designated in advance.

Specific Example

[0075] Next, a specific example of reconnection to a wireless LAN described in Example 1 will be described.

FIG. **5** is a diagram for explaining automatic recovery according to Example 1. As illustrated in FIG. **5**, in the classroom **1**, a class is held by the tablet terminal **30** for teacher, the tablet terminals **40**, **60**, and **80** for students, and the management computer **10** being coupled to each other by a wireless LAN via the access point **2**. In this state, it is assumed that the tablet terminal **40** is disconnected from the access point **2**.

[0076] The management computer **10** obtains connection status from the access point **2** and detects unexpected disconnection of the tablet terminal **40** (S**1**). At this time, the management computer **10** obtains disconnection time from the connection status.

[0077] Next, the management computer **10** specifies a beacon pattern assigned to the tablet terminal **40** from the beacon pattern DB **13** and broadcasts an advertised packet including the disconnection time by using the specified beacon pattern (S**2**).

[0078] Thereafter, each of the tablet terminals **40**, **60**, and **80** receives the advertised packets. When the tablet terminal **40** among the tablet terminals **40**, **60**, and **80** receives the advertised packets with a beacon pattern assigned to the tablet terminal **40**, the tablet terminal **40** determines that the advertised packets are addressed to the tablet terminal **40**. When disconnection time included in each of the advertised packets matches with disconnection time stored in the disconnection time DB **45** of the tablet terminal **40**, the tablet terminal **40** executes restarting (S**3**).

[0079] In this way, the management computer **10** executes automatic connection of a tablet terminal disconnected from a wireless LAN via a wireless network different from a wireless LAN.

[0080] Flow of Process

[0081] Next, a process of each of devices will be described. Here, a process of the management computer **10** and a process of a disconnected tablet terminal will be described. As an example, a disconnected tablet terminal is the tablet terminal **40**.

[0082] Process of Management Computer **10**

[0083] FIG. **6** is a flowchart illustrating a flow of a process of the management computer **10** according to Example 1. As illustrated in FIG. **6**, when connection of all of tablet terminals is completed (Yes in S**101**), the pattern generating unit **16** of the management computer **10** generates a beacon pattern (S**102**). Thereafter, the delivering unit **17** delivers the beacon pattern to each of the tablet terminals via the access point **2** (S**103**). In the case, the pattern generating unit **16** may receive a notification of connection completion from the access point **2** or may also determine the connection completion from connection status obtained from the access point **2**.

[0084] Next, upon obtaining the connection status from the access point **2** (S**104**), the monitoring unit **18** determines whether or not an unconnected tablet terminal exists (S**105**). Here, the monitoring unit **18** stores a disconnection reason and the like in the connection status DB **14**. In a case where an unconnected tablet terminal does not exist (No in S**105**), the monitoring unit **18** repeats S**104** and the following steps.

[0085] In a case where the monitoring unit **18** determines that an unconnected tablet terminal exists (Yes in S**105**), the instruction notification unit **19** obtains a disconnection reason and disconnection time (S**106**). The disconnection reason may be determined also by the management computer **10** and the access point **2** by using the similar method.

[0086] Thereafter, in a case where the disconnection reason is "unexpected disconnection" (Yes in S**107**), the instruction notification unit **19** specifies a beacon pattern corresponding to a tablet terminal of "unexpected disconnection" from the beacon pattern DB **13** (S**108**). Next, the instruction notification unit **19** transmits an advertised packet including the disconnection time with the corresponding beacon pattern as a BLE beacon (S**109**). Thereafter, S**104** and the following steps are repeated.

[0087] On the other hand, in a case where the disconnection reason is not "unexpected disconnection" (No in S**107**), the instruction notification unit **19** determines that a class is ended and deletes a beacon pattern stored in the beacon pattern DB **13** (S**110**).

[0088] Process of Tablet Terminal **40**

[0089] FIG. **7** is a flowchart illustrating a flow of a process of the tablet terminal **40** according to Example 1. As illustrated in FIG. **7**, after connection to a wireless LAN is completed (Yes in S**201**), the receiver **48** of the tablet terminal **40** receives a beacon pattern by a wireless LAN via the access point **2** and saves the beacon pattern in the beacon pattern DB **44** (S**202**).

[0090] Thereafter, upon detecting a tablet disconnected from a wireless LAN (Yes in S**203**), the controller **46** determines whether or not a disconnection reason is unexpected disconnection (S**204**). Here, in a case where it is determined that the disconnection reason is unexpected disconnection (Yes in S**204**), the controller **46** saves the disconnection time in the disconnection time DB **45** (S**205**).

[0091] Thereafter, in a case where a BLE beacon is received (Yes in S**206**) and it is determined that the BLE beacon is addressed to the tablet terminal **40**, based on the beacon pattern (Yes in S**207**), the reconnection unit **49** extracts disconnection time from each of advertised packets transmitted as a BLE beacon (S**208**).

[0092] In a case where the extracted disconnection time matches with disconnection time stored in the disconnection time DB **45** (Yes in S**209**), the reconnection unit **49** executes a reconnecting process (S**210**) and reconnects to a wireless LAN (S**211**). Thereafter, S**203** and the following steps are repeated.

[0093] On the other hand, in a case where the extracted disconnection time does not match with disconnection time stored in the disconnection time DB **45** (No in S**209**), the flow returns to S**206** and the reconnection unit **49** waits for receiving a BLE beacon. In a case where it is determined that the disconnection reason is not unexpected disconnection in S**204** (No in S**204**), the controller **46** deletes a beacon pattern from the beacon pattern DB **44** (S**212**).

[0094] Effect

[0095] As described above, even in a case where a low-performance tablet terminal is used, the management computer **10** may be automatically recovered from a trouble of a wireless LAN connection without going through a person. As a result, it is possible to provide an environment which minimizes class stop time.

[0096] In addition, in a case where a wireless LAN disconnection occurs and a BLE beacon which each of tablet terminals for students receives is addressed to the tablet terminal for student, pieces of information about disconnection time are compared and wireless LAN recovery operation is performed when the pieces of information about disconnection time match with each other. Therefore, since the tablet terminal for student receives the BLE beacon only

when disconnected from a wireless LAN and performs wireless LAN recovery operation only when pieces of information about disconnection time match with each other, it is possible to realize more securely remote recovery. In addition, since only disconnection time is transmitted and leakage of address information of a tablet terminal may be suppressed even if the disconnection time leaks to an outside, the management computer **10** may minimize damage caused by a malicious third party.

EXAMPLE 2

[0097] In Example 1, an example in which a reconnection instruction is notified to a tablet terminal in a state of the tablet terminal being disconnected by using a beacon pattern and broadcasting is described, but the example is not limited thereto. For example, it is also possible to directly connect to a tablet terminal during disconnection and to execute a reconnecting process by using a Bluetooth® (hereinafter, may be referred to as "BT"). Therefore, in Example 2, an example in which the management computer **10** is directly connected to a tablet terminal during disconnection and causes the tablet terminal to execute a reconnecting process and to automatically recover the connection to a wireless LAN will be described.

[0098] Description of Automatic Recovery of Example 2

[0099] FIG. **8** is a diagram for explaining automatic recovery according to Example 2. An overall configuration of a system illustrated in FIG. **8** is the same as that of Example 1.

[0100] As illustrated in FIG. **8**, in a state in which a class is held using a wireless LAN in the classroom **1**, the management computer **10** obtains connection status from the access point **2** and detects unexpected disconnection of the tablet terminal **40** (S**11**). At this time, the management computer **10** obtains disconnection time from the connection status.

[0101] Next, the management computer **10** directly connects to the tablet terminal **40** during the disconnection from a wireless LAN by using BT, and issues a restarting command to the tablet terminal **40** (S**12**). As a result, the tablet terminal **40** is able to automatically reconnect to a wireless LAN (S**13**).

[0102] Functional Configuration

[0103] Next, functional configurations of devices illustrated FIG. **8** will be described. Here, among functional configurations of the management computer **10** and the tablet terminal **40**, functions different from those of Example 1 will be described. The same reference numerals are given to the same functions, but different processes will be separately described even if the same reference numerals are given.

[0104] Functional Configuration of Management Computer **10**

[0105] FIG. **9** is a functional block diagram illustrating a functional configuration of each of devices according to Example 2. As illustrated in FIG. **9**, the management computer **10** includes the communication unit **11**, the storage unit **12**, and the controller **15**.

[0106] The storage unit **12** is a storage device which stores a program executed by the controller **15** or various kinds of data and is, for example, a memory or a hard disk. The storage unit **12** stores the connection status DB **14** and an address information DB **20**.

[0107] The address information DB **20** is address information used for BT connection and stores a Bluetooth® Device address (BD address) of each of the tablet terminals. Information stored therein is set and changed by an administrator or the like.

[0108] FIG. **10** is a diagram illustrating an example of information stored in the address information DB **20**. As illustrated in FIG. **10**, the address information DB **20** stores "tablet terminal", "MAC address", and "BD address" in association with each other. "tablet terminal" is a name of a tablet terminal used by a student, and "MAC address" is a MAC address of the tablet terminal for each student. "BD address" is address information used for BT connection.

[0109] In the example in FIG. **10**, a MAC address of a tablet terminal of the student C is "A1:B2:C3:F3:E2:D3" and a BD address thereof is "B1:C2:D3:G3:F2:E3".

[0110] The controller **15** is a processing unit which manages the whole of the management computer **10** and is, for example, a processor or the like. The controller **15** includes a monitoring unit **21**, an establishing unit **22**, and a reconnection unit **23**. The monitoring unit **21**, the establishing unit **22**, and the reconnection unit **23** are an example of an electronic circuit included in a processor or the like or an example of a process executed by the processor.

[0111] The monitoring unit **21** executes the same process as the monitoring unit **18** described Example 1. For example, the monitoring unit **21** obtains connection status (status and disconnection time) from the access point **2** and monitors whether or not unexpected disconnection occurs. For example, the monitoring unit **21** regularly obtains connection status from the access point **2** and saves the obtained connection status in the connection status DB **14**. Then, in a case of detecting status "unconnected" during a class, the monitoring unit **21** sets "unexpected disconnection" to "disconnection reason" of a tablet terminal corresponding to "unconnected".

[0112] The establishing unit **22** is a processing unit which establishes BT connection with a tablet terminal being disconnected from wireless LAN. For example, upon detecting, with reference to the connection status DB **14**, a tablet terminal for which "unexpected disconnection" is registered, the establishing unit **22** specifies a BD address of the corresponding tablet terminal from the address information DB **20**. The establishing unit **22** executes BT connection by designating the specified BD address and establishes BT connection with the tablet terminal being disconnected from wireless LAN.

[0113] For example, upon detecting "unexpected disconnection" of a tablet terminal of the student C with reference to the connection status DB **14**, the establishing unit **22** obtains a BD address "B1:C2:D3:G3:F2:E3" of the tablet terminal of the student C from the address information DB **20**. The establishing unit **22** designates the BD address "B1:C2:D3:G3:F2:E3" to transmit a BT connection request. Thereafter, upon receiving a connection response, the establishing unit **22** establishes BT connection with a tablet terminal of the student C to which the BD address "B1:C2:D3:G3:F2:E3" is set.

[0114] The reconnection unit **23** is a processing unit which causes the tablet terminal disconnected from a wireless LAN to execute a reconnecting process. For example, the reconnection unit **23** issues start operation or a command of the reconnecting process by BT communication to the tablet terminal in which BT connection is established by the

establishing unit **22**. In the above example, the reconnection unit **23** issues a command or the like of restarting by BT connection to the tablet terminal of the student C in which BT connection is established.

[0115] When the tablet terminal of the student C is restarted, the reconnection unit **23** automatically establishes BT connection with the tablet terminal of the student C. Then, the reconnection unit **23** determines that reconnection to a wireless LAN is completed and automatically disconnects BT connection.

[0116] Functional Configuration of Tablet Terminal **40**

[0117] As illustrated in FIG. **9**, the tablet terminal **40** includes the communication unit **41**, the display unit **42**, the storage unit **43**, and the controller **46**.

[0118] A difference from FIG. **2** described in Example 1 is that the storage unit **43** does not store the beacon pattern DB **44**. In addition, since the reconnection unit **49** of the controller **46** includes a process different from Example 1, the process will be described.

[0119] The reconnection unit **49** is a processing unit which establishes BT connection with the management computer **10** and receives an instruction for a reconnecting process via the BT connection, in contrast with Example 1. For example, in a case where "unexpected disconnection" is detected by the controller **46**, the reconnection unit **49** moves to a waiting state for BT connection. Thereafter, upon receiving a connection request by BT from the management computer **10**, the reconnection unit **49** transmits a connection response to the management computer **10** by using BT.

[0120] In this way, in a state in which the reconnection unit **49** may not be connected to a wireless LAN, the reconnection unit **49** establishes BT connection with the management computer **10**. Thereafter, the reconnection unit **49** receives a restarting command or the like from the management computer **10** via BT connection. The tablet terminal **40** executes restarting by receiving a restarting command from the management computer **10**. Restarting may be performed remotely by the management computer **10** or performed locally by the management computer **10**.

[0121] Thereafter, when the tablet terminal **40** is restarted, the reconnection unit **49** automatically establishes BT connection with the management computer **10**. Thereafter, when the reconnection unit **49** determines that reconnection to a wireless LAN is completed, the reconnection unit **49** automatically disconnects BT connection.

[0122] Flow of Process

[0123] Next, a process of each of devices according to Example 2 will be described. Here, a process of the management computer **10** and a process of a tablet terminal will be described. As an example, a disconnected tablet terminal is the tablet terminal **40**.

[0124] Process of Management Computer **10**

[0125] FIG. **11** is a flowchart illustrating a flow of a process of the management computer **10** according to Example 2. As illustrated in FIG. **11**, when connection of all of the tablet terminals is completed (Yes in S**301**) and connection status is obtained from the access point **2** (S**302**), the monitoring unit **21** of the management computer **10** determines whether or not an unconnected tablet terminal exists (S**303**). Here, in a case where an unconnected tablet terminal does not exist (No in S**303**), the monitoring unit **21** repeats S**302** and the following steps.

[0126] In a case where the monitoring unit **21** determines that an unconnected tablet terminal exists (Yes in S**303**), the establishing unit **22** obtains a disconnection reason and disconnection time (S**304**).

[0127] Thereafter, in a case where the disconnection reason is "unexpected disconnection" (Yes in S**305**), the establishing unit **22** specifies address information (BD address) of a tablet terminal being disconnected corresponding to "unexpected disconnection", from the address information DB **20** (S**306**).

[0128] Next, the establishing unit **22** transmits a request for BT connection by designating the specified address information (S**307**). Upon receiving a connection response (Yes in S**308**), the establishing unit **22** completes BT connection with the tablet terminal being disconnected (S**309**).

[0129] The reconnection unit **23** causes, by using BT, the tablet terminal being disconnected to execute a reconnecting process (S**310**). In a case where connection completion of the unconnected tablet is confirmed according to the connection status afterward obtained by the monitoring unit **21** (Yes in S**312**), the reconnection unit **23** disconnects BT (S**313**). Thereafter, S**302** and the following steps are repeated.

[0130] On the other hand, in a case where the unconnected tablet terminal is detected in the connection status afterward obtained by the monitoring unit **21** and connection completion of the unconnected tablet is not confirmed (No in S**312**), the reconnection unit **23** returns to S**310** and executes the reconnecting process to the tablet terminal being disconnected again. The reconnection unit **23** may execute S**313** without executing S**311** and S**312** assuming that reconnection to a wireless LAN is completed. Even in this case, since an unconnected state is detected by obtaining the next connection status, the reconnecting process may be repeatedly executed.

[0131] On the other hand, in a case where it is determined that the disconnection reason is not "unexpected disconnection" (No in S**305**), the process is ended.

[0132] Process of Tablet Terminal **40**

[0133] FIG. **12** is a flowchart illustrating a flow of a process of the tablet terminal **40** according to Example 2. As illustrated in FIG. **12**, after connection to a wireless LAN is completed (Yes in S**401**), upon detecting disconnection from a wireless LAN (Yes in S**402**), the controller **46** of the tablet terminal **40** determines whether or not a disconnection reason is unexpected disconnection (S**403**). Here, in a case where the disconnection reason is not unexpected disconnection (No in S**403**), the controller **46** ends the process.

[0134] On the other hand, in a case where the controller **46** determines that the disconnection reason is unexpected disconnection (Yes in S**403**), the reconnection unit **49** moves to a waiting state for BT connection (S**404**). Upon receiving a request for BT connection from the management computer **10** (Yes in S**405**), the reconnection unit **49** transmits a response for BT connection to the management computer **10** (S**406**). Then, the reconnection unit **49** completes BT connection (S**407**).

[0135] Thereafter, upon receiving a reconnection request via BT (Yes in S**408**), the reconnection unit **49** execute the reconnecting process (S**409**), reconnects to a wireless LAN (S**410**), and disconnects BT (S**411**). The reconnection unit **49** may control BT to disconnect BT after reconnection to a

wireless LAN succeeds, or may control BT to disconnect BT regardless of success or failure of reconnection after restarting is completed.

[0136] Effect

[0137] In this way, the management computer **10** transmits a reconnection operation instruction to a tablet terminal of a student, and the tablet terminal of the student executes reconnection operation. When the tablet terminal of the student is reconnected to a wireless LAN, the tablet terminal disconnects BT connection. Therefore, since the tablet terminal of the student establishes BT connection only during a time period in which reconnection operation to a wireless LAN is being performed, it is possible to minimize power consumption. In addition, since the management computer **10** is directly connected to a tablet terminal being disconnected and causes the tablet terminal to execute reconnection, it is possible to improve a probability of success in reconnection.

EXAMPLE 3

[0138] Although the examples of the embodiment are described so far, the embodiment may be implemented in various different forms in addition to the examples described above. Therefore, different examples will be described below.

[0139] Wireless Line

[0140] Although a wireless LAN or BLE, a wireless LAN and BT, and the like are described as examples in the above examples, the embodiment is not limited thereto. For example, instead of BT or BLE, other non-contact communication or the like may be adopted.

[0141] In addition, since advertising channel frequencies (37 ch, 38 ch, and 39 ch) used for the above BLE beacon are not overlapped with channel frequencies (1 ch, 6 ch, and 11 ch) used for an ordinary wireless LAN, it is possible to reduce failure due to radio wave interference. In addition, a beacon is not limited to BLE, another beacon may be adopted, and channels may also be used for other channels not used for a wireless LAN and the like.

[0142] Tablet Terminal

[0143] Although a tablet terminal for student is described as a target of automatic recovery in the above examples, the embodiment is not limited thereto and a tablet terminal for teacher may be a target of automatic recovery. In addition, not only a tablet terminal but also another computer such as a smartphone, a server, or the like may be a target of automatic recovery.

[0144] Transmission Information

[0145] Although an example in which disconnection time is transmitted by a BLE beacon is described in Example 1, it is possible to execute only a notification using a beacon pattern without transmitting disconnection time. By transmitting the disconnection time, it is possible to execute a two-step determination of a notification using the beacon pattern and a coincidence of the disconnection time, thereby improving a security level.

[0146] Environment

[0147] Although a wireless LAN in a classroom is described as an example in the above examples, the embodiment is not limited thereto and may apply to inside a hospital, inside a warehouse, inside a vehicle, or the like in the same manner.

[0148] Hardware Configuration of Management Computer **10**

[0149] FIG. **13** is a diagram illustrating an example of a hardware configuration of the management computer **10**. As illustrated in FIG. **13**, the management computer **10** includes a power supply unit **10***a*, a BLE unit **10***b*, a wireless LAN unit **10***c*, a hard disk drive (HDD) **10***d*, a memory **10***e*, and a processor **10***f*.

[0150] The power supply unit **10***a* controls a power supply of the management computer **10**. The BLE unit **10***b* executes transmission control of a BLE beacon. The wireless LAN unit **10***c* is coupled to a wireless LAN via the access point **2** and executes transmission and reception of data. The HDD **10***d* is an example of a storage device which stores a program, data, and the like.

[0151] An example of the memory **10***e* is a random access memory (RAM) such as a synchronous dynamic random access memory (SDRAM), a read only memory (ROM), a flash memory, or the like. An example of the processor **10***f* is a central processing unit (CPU), a digital signal processor (DSP), a field programmable gate array (FPGA), a programmable logic device (PLD), or the like.

[0152] In addition, the management computer **10** operates as an information processing device which executes a reconnection method by reading and executing a program. That is, the management computer **10** executes a program which executes the same function as the pattern generating unit **16**, the delivering unit **17**, the monitoring unit **18**, and the instruction notification unit **19**. As a result, the management computer **10** is able to execute a process which executes the same function as the pattern generating unit **16**, the delivering unit **17**, the monitoring unit **18**, and the instruction notification unit **19**. A program according to the embodiment is not limited to being executed by the management computer **10**. For example, even in a case where another computer or another server executes a program or a case where the computer and the server execute a program in cooperation with each other, the embodiment may be applied in the same manner. The same applies to a program which executes the same function as each of functional units described in Example 2.

[0153] This program may be distributed via a network such as the Internet. In addition, the program is recorded in a computer readable recording medium such as a hard disk, a flexible disk (FD), a CD-ROM, a magneto-optical disk (MO), a digital versatile disc (DVD) and can be executed by a computer reading from the recording medium.

[0154] Hardware Configuration of Tablet Terminal **40**

[0155] FIG. **14** is a diagram illustrating an example of a hardware configuration of the tablet terminal **40**. As illustrated in FIG. **14**, the tablet terminal **40** includes a power supply unit **40***a*, a BLE unit **40***b*, a wireless LAN unit **40***c*, a touch panel **40***d*, a display unit **40***e*, an HDD **40***f*, a memory **40***g*, and a processor **40***h*.

[0156] The power supply unit **40***a* controls a power supply of the tablet terminal **40**. The BLE unit **40***b* executes reception control of a BLE beacon. The wireless LAN unit **40***c* is coupled to a wireless LAN via the access point **2** and executes transmission and reception of data.

[0157] The touch panel **40***d* is an input unit which is overlapped with the display unit **40***e* and accepts user operation, and outputs an operated position (coordinate) on the processor **40***h*. The touch panel **40***d* may adopt various methods such as a capacitive method and an electromagnetic

induction method. The display unit **40***e* is an example of a display unit which displays various kinds of information.

[0158] The HDD **40***f* is an example of a storage device which stores a program, data, and the like. An example of the memory **40***g* is a RAM such as an SDRAM and the like, a ROM, a flash memory, or the like. An example of the processor **40***h* is a CPU, a DSP, an FPGA, a PLD, or the like.

[0159] In addition, the tablet terminal **40** operates as an information processing device which executes a reconnection method by reading and executing a program. That is, the tablet terminal **40** executes a program which executes the same function as the display controller **47**, the receiver **48**, and the reconnection unit **49**. As a result, the tablet terminal **40** is able to execute a process which executes the same function as the display controller **47**, the receiver **48**, and the reconnection unit **49**. A program according to the embodiment is not limited to being executed by the tablet terminal **40**. For example, even in a case where another computer or another server executes a program or a case where the computer and the server execute a program in cooperation with each other, the embodiment may be applied in the same manner.

[0160] This program may be distributed via a network such as the Internet. In addition, the program is recorded in a computer readable recording medium such as a hard disk, a flexible disk (FD), a CD-ROM, an MO, and a DVD and can be executed by a computer reading from the recording medium.

[0161] System

[0162] In addition, among all processes described in the present examples, all or a part of the processes explained as being automatically performed can also be performed manually. Alternatively, all or a part of the processes described as being performed manually can be automatically performed by a known method. Further, processing procedures, control procedures, specific names, and information including various data and parameters illustrated in the document or in the drawings can be arbitrarily changed unless otherwise noted.

[0163] In addition, each of components of each of devices illustrated in the drawing is functionally conceptual and is not desirable to be physically configured as illustrated in the drawing. In other words, specific forms of distribution and integration of each of the devices are not limited to those illustrated in the drawings. That is, all or a part thereof may be configured by being functionally or physically distributed and integrated as arbitrary units according to various loads and use situations. Further, all or an arbitrary part of each of processing functions performed in each of the devices may be realized by a CPU and a program analyzed and executed by the CPU, or may be realized as hardware by wired logic.

[0164] All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the invention and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although the embodiments of the present invention have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. An apparatus comprising:

a memory; and

a processor coupled to the memory and configured to:

obtain connection status information of each of terminal devices coupled to a first wireless network via an access point, from the access point,

detect a disconnected device which is a terminal device whose communication with the access point is disconnected, with reference to the connection status information, and

notify, via a second wireless network, the disconnected device of a reconnection instruction for causing the disconnected device to reconnect to the first wireless network by accessing the access point.

2. The apparatus of claim **1**, wherein

the processor is further configured to deliver a beacon pattern assigned to each of the terminal devices to each terminal device, the beacon pattern being a combination of transmission frequency channels of a beacon used for the second wireless network; and

the processor notifies the disconnection device among the terminal devices of the reconnection instruction by broadcasting a beacon including the reconnection instruction in accordance with a beacon pattern assigned to the disconnected device.

3. The apparatus of claim **2**, wherein

the processor extracts a disconnection time at which communication between the disconnected device and the access point is disconnected, and

the processor causes the disconnected device which holds the disconnection time to execute a process of reconnecting to the first wireless network, by broadcasting a beacon including the disconnection time in accordance with a beacon pattern assigned to the disconnected device.

4. The apparatus of claim **1**, wherein

the processor is further configured to store address information which is used in the second wireless network by the terminal devices; and

the processor establishes connection with the disconnected device via the second wireless network by using the address information assigned to the disconnected device, and restarts the disconnected device to reconnect to the first wireless network.

5. A method comprising:

obtaining connection status information of each of terminal devices coupled to a first wireless network via an access point, from the access point;

detecting a disconnected device which is a terminal device whose communication with the access point is disconnected, with reference to the connection status information; and

notifying, via a second wireless network, the disconnected device of a reconnection instruction for instructing the disconnected device to reconnect to the first wireless network by accessing the access point.

6. A non-transitory, computer-readable recording medium having stored therein a program for causing a computer to execute a process comprising:

obtaining connection status information of each of terminal devices coupled to a first wireless network via an access point, from the access point;

detecting a disconnected device which is a terminal device whose communication with the access point is disconnected, with reference to the connection status information; and

notifying, via a second wireless network, the disconnected device of a reconnection instruction for instructing the disconnected device to reconnect to the first wireless network by accessing the access point.

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